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DECLARATION

I, Kazuhiko YANAGAWA, a national of Japan, c/o HITACHI Ltd. of Marunouchi Center Building 12F, Marunouchi 1-chome, Chiyoda-ku, Tokyo do hereby solemnly and sincerely declare:-

1) THAT I am well acquainted with Japanese language and English language, and
2) THAT the attached is a full, true, accurate and faithful translation into the English language made by me of Japanese Patent Application No. 2002-299063.

The undersigned declares further that all statements made herein of his own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001, of Title 18 of the United States Code and that such willful false statements mat jeopardize the validity of the application or any patent issuing thereon.

Signed this 2nd day of February, 2006.

Kazuhiko Yanagawa

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[Title of the Invention] Image display device

[Claim 1]

An image display device comprising an image display panel, a first printed circuit board which is arranged close to the image display panel, and a second printed circuit board which is arranged in a state that the second printed circuit board strides over the image display panel and the first printed circuit board, wherein

the second printed circuit board is configured in a state that at least a wiring layer which allows the inputting of signals from the first printed circuit board side thereto and the outputting of signals to the image display panel side therefrom is formed on a surface of a flexible printed circuit board, and

the first printed circuit board includes, on a side thereof opposite to the image display panel, a portion thereof having a width smaller than a width of the first printed circuit board.

[Claim 2]

An image display device comprising an image display panel, a first printed circuit board which is arranged close to the image display panel, and a second printed circuit board which is arranged in a state that the second printed circuit board strides over the image display panel and the first printed circuit board, wherein

the second printed circuit board is configured in a state that at least a wiring layer which allows the inputting of signals from the first printed circuit board side thereto and the outputting of signals to the image display panel side therefrom is formed on a surface of a flexible printed circuit board, and

the first printed circuit board includes a notched portion on a side thereof opposite to the image display panel.

[Claim 3]

An image display device comprising an image display panel, a first printed circuit board which is arranged close to the image display panel, and a second printed circuit board which is arranged in a state that the second printed circuit board strides over the image display panel and the first printed circuit board, wherein

the second printed circuit board is configured in a state that at least a wiring layer which allows the inputting of signals from the first printed circuit board side thereto and the outputting of signals to the image display panel side therefrom is formed on a surface of a flexible printed circuit board, and

the first printed circuit board includes a plurality of notched portions from one side to another side on a side thereof opposite to the image display panel.

[Claim 4]

An image display device according to any one of claims 1 to 3, wherein the second printed circuit board mounts a semiconductor device which is connected with the wiring layer formed on a surface thereof.

[Claim 5]

An image display device according to any one of claims 1 to 3, wherein the pixel display panel includes, on a surface thereof, gate signal lines which supply a scanning signal to a pixel group which is formed of respective pixels arranged in parallel in one direction and drain signal lines which supply a video signal to each pixel to which the scanning signal is supplied, and

the second printed circuit board constitutes a scanning signal drive circuit which supplies the scanning signal to the gate signal lines and also constitutes a video signal drive circuit which supplies the video signal to the drain signal lines.

[Claim 6]

An image display device according to claim 5, wherein the first printed circuit board which is connected with the scanning signal drive circuit and the first printed circuit board which is connected with the video signal drive circuit per se are formed separately from each other.

[Claim 7]

An image display device according to claim 6, wherein the notched portion is formed on at least either one of the first printed circuit board which is connected with the second printed circuit board which constitutes the scanning signal drive circuit and the first printed circuit board which is connected with the second printed circuit board which constitutes the video signal drive circuit.

[Claim 8]

An image display device according to claim 6, wherein second dummy printed circuit boards which do not contribute to the signal transmission are arranged between at least either one of the first printed circuit board which is connected with the second printed circuit board which constitutes the scanning signal drive circuit and the first printed circuit board which is connected with the second printed circuit board which constitutes the video signal drive circuit and the image display panel at both ends thereof.

[Claim 9]

An image display device comprising an image display panel, a first printed circuit board which is arranged close to the image display panel, a second printed circuit board which is arranged in a state that the second printed circuit board strides over the pixel display panel and the first printed circuit board, and a frame which is arranged to surround the pixel display panel, the second printed circuit board and the image display panel, wherein

the second printed circuit board is configured in a state that at least a wiring layer which allows the inputting of signals from the first printed circuit board side thereto and the outputting of signals to the image display panel side therefrom is formed on a surface of a flexible printed circuit board, and

the first printed circuit board includes a notched portion on a side thereof opposite to the image display panel, and a projecting portion which is engaged with the notched portion is formed on the frame.

[Claim 10]

An image display device comprising an image display panel, a first printed circuit board which is arranged close to the image display panel, and a second printed circuit board which is arranged in a state that the second printed circuit board strides over the pixel display panel and the first printed circuit board, wherein

the second printed circuit board is configured in a state that at least a wiring layer which allows the inputting of signals from the first printed circuit board side thereto and the outputting of signals to the image display panel side therefrom is formed on a surface of a flexible printed circuit board,

the first printed circuit board includes a notched portion on a side thereof opposite to the image display panel, and

a connector or a flat cable which performs wiring from one surface to another surface of the first printed circuit board is arranged in the inside of the notched portion.

[Designation of Document] Specification

[0001]

[Technical Field to which the Invention Belongs]

The present invention relates to an image display device, and more particularly to an image display device which arranges a semiconductor device which is formed in a so-called tape carrier method between an image display panel and a printed circuit board which is arranged close to the image display panel, for example.

[0002]

[Background of the Invention]

For example, an active-matrix type liquid crystal display device includes, in the inside of panel thereof, gate signal lines which supply scanning signals to a pixel group constituted of respective pixels arranged in parallel in one direction and drain signal lines which supply video signals to respective pixels to which the scanning signals are supplied.

[0003]

Each pixel is constituted of a switching element which is operated in response to the supply of the scanning signal, a pixel electrode to which the signal from the drain signal line is supplied through the switching element, and a counter electrode which generates an electric field for controlling a light transmissivity of liquid crystal between the counter electrode and the pixel electrode.

[0004]

Further, the supply of the scanning signals to the gate signal lines and the supply of the vide signals to the drain signal lines are respectively performed by a scanning signal drive circuit and a video signal drive circuit (also referred to as signal drive circuits hereinafter) which are arranged in an astride manner between a panel and a printed circuit board which is arranged close to the panel, for example, wherein these drive circuits are constituted of a semiconductor device formed in a tape carrier method.

[0005]

Here, the tape-carrier-type semiconductor device includes an input-side wiring layer having input terminals and an output-side wiring layer having output terminals on a flexible printed circuit board, a semiconductor chip is mounted between the input-side wiring layer and the output-side wiring layer, a semiconductor chip is mounted on the flexible wiring board between the input-side wiring layer and the output-side wiring layer, and input-side bumps are connected with the input-side wiring layer, and output-side bumps are connected with the output-side wiring layer.

[0006]

[Problem to be solved by the Invention]

However, in the liquid crystal display device having such a constitution, a thermal expansion coefficient of the printed circuit board is higher than a thermal expansion coefficient of the panel and hence, a stress strain which is generated due to the expansion of the printed circuit board is transmitted to the above-mentioned signal drive circuits.

[0007]

As a result, it has been pointed out that the disconnection of the wiring layer which is formed on the signal drive circuit or the defective connection between the mounted semiconductor device and wiring layer. These drawbacks become conspicuous recently along with the large-sizing of the liquid crystal display panel.

The present invention has been made under such circumstances and it is an object of the present invention to provide an image display device which can obviate the disconnection in a signal drive circuit or the like.

[0008]

[Means for solving the Task]

To briefly explain the summary of typical inventions among inventions described in this specification, they are as follows.

[0009]

Means 1.

An image display device according to the present invention includes, for example, an image display panel, a first printed circuit board which is arranged close to the image display panel, and a second printed circuit board which is arranged in a state that the second printed circuit board strides over the image display panel and the first printed circuit board, wherein the second printed circuit board is configured in a state that at least a wiring layer which allows the inputting of signals from the first printed circuit board side thereto and the outputting of signals to the image display panel side therefrom is formed on a surface of a flexible printed circuit board, and

the first printed circuit board includes, on a side thereof opposite to the image display panel, a portion thereof having a width smaller than a width of the first printed circuit board.

[0010]

Means 2.

An image display device according to the present invention includes, for example, an image display panel, a first printed circuit board which is arranged close to the image display panel, and a second printed circuit board which is arranged in a state that the second printed circuit board strides over the image display panel and the first printed circuit board, wherein

the second printed circuit board is configured in a state that at least a wiring layer which allows the inputting of signals from the first printed circuit board side thereto and the outputting of signals to the image display panel side therefrom is formed on a surface of a flexible printed circuit board, and

the first printed circuit board includes a notched portion on a side thereof opposite to the image display panel.

[0011]

Means 3.

An image display device according to the present invention includes, for example, an image display panel, a first printed circuit board which is arranged close to the image display panel, and a second printed circuit board which is arranged in a state that the second printed circuit board strides over the image display panel and the first printed circuit board, wherein

the second printed circuit board is configured in a state that at least a wiring layer which allows the inputting of signals from the first printed circuit board side thereto and the outputting of signals to the image display panel side therefrom is formed on a surface of a flexible printed circuit board, and

the first printed circuit board includes a plurality of notched portions from one side to another side on a side thereof opposite to the image display panel.

[0012]

Means 4.

An image display device according to the present invention is, for example, on the premise of any one of means 1 to 3, characterized in that the second printed circuit board mounts a semiconductor device which is connected with the wiring layer formed on a surface thereof.

[0013]

Means 5.

An image display device according to the present invention is, for example, on the premise of any one of means 1 to 3, characterized in that the pixel display panel includes, on a surface thereof, gate signal lines which supply a scanning signal to a pixel group which is formed of respective pixels arranged in parallel in one direction and drain signal lines which supply a video signal to the pixel to which the scanning signal is supplied, and

the second printed circuit board constitutes a scanning signal drive circuit which supplies the scanning signal to the gate signal lines and also constitutes a video signal drive circuit which supplies the video signal to the drain signal lines.

[0014]

Means 6.

An image display device according to the present invention is, for example, on the premise of claim 5, characterized in that the first printed circuit board which is connected with the scanning signal drive circuit and the first printed circuit board which is connected with the video signal drive circuit per se are formed separately from each other.

[0015]

Means 7.

An image display device according to the present invention is, for example, on the premise of claim 6, characterized in that the notched portion is formed on at least either one of the first printed circuit board which is connected with the second printed circuit board which constitutes the scanning signal drive circuit and the first printed circuit board which is connected with the second printed circuit board which constitutes the video signal drive circuit.

[0016]

Means 8.

An image display device according to the present invention is, for example, on the premise of claim 6, characterized in that second dummy printed circuit boards which do not contribute to the signal transmission are arranged between at least either one of the first printed circuit board which is connected with the second printed circuit board which constitutes the scanning signal drive circuit and the first printed circuit board which is connected with the second printed circuit board which constitutes the video signal drive circuit and the image display panel at both ends thereof.

[0017]

Means 9.

An image display device according to the present invention includes, for example, an image display panel, a first printed circuit board which is arranged close to the image display panel, a second printed circuit board which is arranged in a state that the second printed circuit board strides over the pixel display panel and the first printed circuit board, and a frame which is arranged to surround the pixel display panel, the second printed circuit board and the image display panel, wherein

the second printed circuit board is configured in a state that at least a wiring layer which allows the inputting of signals from the first printed circuit board side thereto and the outputting of signals to the image display panel side therefrom is formed on a surface of a flexible printed circuit board, and

the first printed circuit board includes a notched portion on a side thereof opposite to the image display panel, and a projecting portion which is engaged with the notched portion is formed on the frame.

[0018]

Means 10.

An image display device according to the present invention includes, for example, an image display panel, a first printed circuit board which is arranged close to the image display panel, and a second printed circuit board which is arranged in a state that the second printed circuit board strides over the pixel display panel and the first printed circuit board, wherein

the second printed circuit board is configured in a state that at least a wiring layer which allows the inputting of signals from the first printed circuit board side thereto and the outputting of signals to the image display panel side therefrom is formed on a surface of a flexible printed circuit board,

the first printed circuit board includes a notched portion on a side thereof opposite to the image display panel, and

a connector or a flat cable which performs wiring from one surface to another surface of the first printed circuit board is arranged in the inside of the notched portion.

The present invention is not limited to the above-mentioned constitutions and various modifications can be made without departing from the technical concept of the present invention.

[0019]

[Mode for carrying out the Invention]

Hereinafter, embodiments of a liquid crystal display device according to the present invention are explained in conjunction with drawings.

[0020]

Embodiment 1.

[module of liquid crystal display device]

Fig. 2 is an exploded perspective view showing one embodiment of a module of a liquid crystal display device according to the present invention.

The liquid crystal display device shown in Fig. 2 is roughly constituted of a liquid crystal display panel module 400, a backlight 300, a resin frame body 500, an intermediate frame 700, an upper frame 800 and the like. These components are formed into a module.

[0021]

Here, in this embodiment, a reflector which constitutes a portion of the backlight 300 is formed on a bottom surface of the resin frame body 500. Although the physical distinction between the resin frame body 500 and the backlight 300 is difficult, the resin frame body 500 and the backlight 300 can be separated functionally in the above-mentioned manner.

Hereinafter, the respective members are explained sequentially.

[0022]

[liquid crystal display panel module 400]

The liquid crystal display panel module 400 includes, as shown in Fig. 3 which only takes out and depicts the liquid crystal display panel module 400 from Fig. 2, a liquid crystal display panel PNL, a video signal drive printed circuit board HPCB which is arranged close to one long-side side of the liquid crystal display panel PNL, and a scanning signal drive printed circuit board VPCB which is arranged close to one short-side side of the liquid crystal display panel PNL.

[0023]

Further, between the liquid crystal display panel PNL and the video signal drive printed circuit board HPCB, a video signal drive circuit He which is constituted of a plurality of semiconductor devices formed in a so-called tape carrier method is arranged in an astride manner.

[0024]

Here, with respect to the semiconductor device formed in a so-called tape carrier method, a semiconductor circuit is mounted on an approximately center of a flexible wiring board, input bumps are connected with a wiring layer formed on a front surface of the flexible wiring board by way of terminals from one-side side of the flexible wiring board, and output bumps are connected with a wiring layer formed on a front surface of the flexible wiring board by way of terminals from a side opposite to one-side side of the flexible wiring board.

[0025]

In the same manner, between the liquid crystal display panel PNL and the scanning signal drive printed circuit board VPCB, a scanning signal drive circuit V which is constituted of a plurality of semiconductor devices formed in a so-called tape carrier method is arranged in an astride manner.

[0026]

Signals from a control circuit not shown in the drawing are inputted to the video signal drive circuit He through the video signal drive printed circuit board HPCB and video signals are supplied to the drain signal lines DL of the liquid crystal display panel PNL by the video signal drive circuit He. Further, other signals from the control circuit are inputted to the scanning signal drive circuit V through the scanning signal drive printed circuit board VPCB and the video signals are supplied to the gate signal lines GL of the liquid crystal display panel PNL by the scanning signal drive circuit V.

[0027]

The liquid crystal display panel PNL includes a pair of transparent substrates SUB1, SUB2 which are arranged to face each other with liquid crystal therebetween, wherein the liquid crystal is sealed by a sealing material SL which is also served for fixing another transparent substrate SUB 2 to one transparent substrate SUB1.

[0028]

On a liquid-crystal-side surface of one transparent substrate SUB1 which is surrounded by the sealing material SL, gate signal lines GL which extend in the x direction and are arranged in parallel in the y direction and the drain signal lines DL which extend in the y direction and are arranged in parallel in the x direction are formed.

[0029]

Regions which are surrounded by the respective gate signal lines GL and the respective drain signal lines DL constitute pixel regions and, at the same time, a mass of these respective pixel regions in a matrix array constitutes a liquid crystal display part AR.

[0030]

Further, in respective pixel regions which are arranged in parallel in the x direction, a counter voltage signal line CL which runs across the inside of the respective pixel regions in common is formed. The counter voltage signal line CL constitutes a signal line for supplying a voltage which becomes the reference with respect to video signals to the counter electrode CT of each pixel region described later.

[0031]

In each pixel region, a thin film transistor TFT which is operated in response to the scanning signal from the one-side gate signal line GL and a pixel electrode PX to which the video signal from the one-side drain signal line DL is supplied through the thin film transistor TFT are formed.

[0032]

An electric field is generated between the pixel electrode PX and the counter electrode CT which is connected to the counter voltage signal line CL and the optical transmissivity of the liquid crystal is controlled in response to the electric field.

[0033]

Respective one ends of the gate signal lines GL extend over the sealing material SL and extended ends constitute terminals to which output terminals of the scanning signal drive circuit V are connected. Further, to input terminals of the scanning signal drive circuit V, signals from the scanning signal drive printed circuit board VPCB which is arranged outside the liquid crystal display panel PNL are inputted.

[0034]

The scanning signal drive circuit V is constituted of a plurality of semiconductor devices, wherein a plurality of gate signal lines GL which are arranged close to each other are formed into groups and one semiconductor device is allocated to each group.

[0035]

In the same manner, respective one ends of the drain signal lines DL extend over the sealing material SL and the extended ends constitute terminals to which output terminals of the video signal drive circuit He are connected. Further, to input terminals of the video signal drive circuit He, signals from the video signal drive printed circuit board HPCB which is arranged outside the liquid crystal display panel PNL are inputted.

[0036]

The video signal drive circuit He is also constituted of a plurality of semiconductor devices, wherein a plurality of drain signal lines DL which are arranged close to each other are formed into groups and one semiconductor device is allocated to each group.

Further, the counter voltage signal lines CL have end portions thereof on the right side in the drawing connected to each other in common and the connection line extends over the sealing material SL and terminals are formed on extending ends. A voltage which becomes the reference with respect to the video signal is supplied from the terminals.

[0037]

With respect to the respective gate signal lines GL, one of the gate signal lines GL is sequentially selected in response to the scanning signal from the scanning signal drive circuit V.

[0038]

Further, to the respective drain signal lines DL, the video signal is supplied by the video signal drive circuit He in response to the selection timing of the gate signal line GL.

[0039]

Here, in this embodiment, in Fig. 1 which is a simplified view of Fig. 3 and in which a plurality of video signal drive circuit He and a plurality of scanning signal drive circuit V are shown, for example, slits SLT are formed on a side of the video signal drive printed circuit board HPCB opposite to the liquid crystal display panel PNL.

[0040]

Each slit SLT is formed on the side between respective video signal drive circuits He, for example, wherein the slit-formed portion has a width slightly smaller than a width of other portions of the video signal drive printed circuit board HPCB.

[0041]

In the liquid crystal display panel module 400 having such a constitution, when the video signal drive printed circuit board HPCB is thermally expanded with respect to the liquid crystal display panel PNL due to a temperature change, for example, a stress generated by the thermal expansion is applied to a wiring on the flexible wiring board of the video signal drive circuit He or connecting portions with a semiconductor circuit mounted on the flexible wiring board and hence, it is possible to obtain an advantageous effect that the possibility that the disconnection occurs is largely reduced.

[0042]

That is, the inventors have found out a following phenomenon. That is, a strain of the video signal drive printed circuit board HPCB which is generated due to the difference between a thermal expansion coefficient of the liquid crystal display panel PNL and a thermal expansion coefficient of the video signal drive printed circuit board HPCB provides not only a force of a simple linear direction but also a stress which warps each video signal drive circuit He three-dimensionally. Particularly, with respect to each one of respective video signal drive circuits He which are arranged in parallel to each other, the stress is largely generated in the video signal drive circuits He which are arranged at both sides of each video signal drive circuit He and the stress is concentrated on a side portion opposite to the liquid crystal display panel PNL.

[0043]

From above, as in the case of the above-mentioned embodiments, by forming the slits SLT arranged in parallel in a side portion of the video signal drive printed circuit board HPCB opposite to the liquid crystal display panel PNL, it is possible to disperse the strain attributed to the difference in the above-mentioned thermal expansion coefficient whereby it is possible to prevent the concentration of the strain on the video signal drive circuit He.

[0044]

From the above, it is not always necessary to form the above-mentioned slits SLT only in regions formed between the respective video signal drive circuits He and hence, it is possible to eliminate the concentration of the strain by increasing or decreasing the number of slits SLT than the number of slits SLT in the above-arrangement of slits SLT.

[0045]

Here, Fig. 12 is a view showing a plane of a liquid crystal display panel which is actually designed and shows a left upper corner of the liquid crystal display panel PNL in Fig. 1, wherein a plurality of slits SLT which are arranged in parallel in the longitudinal direction of the video signal drive printed circuit board HPCB are formed in a side of the video signal drive printed circuit board HPCB opposite to the liquid crystal display panel PNL.

[0046]

[Backlight 300]

On a back surface of the liquid crystal display panel module 400, the backlight 300 is arranged.

The backlight 300 is referred to as a so-called "direct type" and is constituted of a plurality of (eight in the drawing) equidistantly-arranged linear light sources 35 which extend in the x direction and are arranged in parallel in the y direction in the drawing and reflectors 36 which are served for irradiating light from the light sources 35 toward the liquid crystal display panel module 400 side.

[0047]

The reflectors 36 are, for example, formed in a wave shape in the parallel direction (y direction) of the light sources 35 thus providing the shape which can effectively irradiate the whole light from the respective light sources 35 to the liquid crystal display panel module side.

[0048]

For example, each one of these light sources 35 is formed of a so-called cold cathode ray tube and the light source 35 is turned on by applying voltage to electrodes formed on both ends of the light source 35.

Further, it is needless to say that the light sources 35 may be formed of a heated cathode fluorescent lamp, a xenon lamp, a vacuum fluorescent display tube or the like.

[0049]

[resin frame body 500]

The resin frame body 500 constitutes a portion of an outer frame of the liquid crystal display device which is formed into a module and is configured to house the above-mentioned backlight 300.

Here, the resin frame body 500 has a box shape having a bottom surface and side surfaces and upper end surfaces of the side surfaces are formed to allow the mounting of a diffusion plate (not shown in the drawing) which is arranged to cover the backlight 300 thereon.

[0050]

The diffusion plate has a function of dispersing light from the respective light sources 35 from the backlight 300 and, due to the provision of the diffusion plate, it is possible to irradiate the uniform light which has no irregularities to the liquid crystal display panel module 400 side.

In this case, the resin frame body 500 is formed with a relatively small wall thickness. This is because that the decrease of a mechanical strength attributed to the small wall thickness is reinforced by the intermediate frame 700 described later.

[0051]

[intermediate frame 700]

Between the liquid crystal display panel module 400 and the diffusion plate (not shown in the drawing), the intermediate frame 700 is arranged.

The intermediate frame 700 is constituted of a metal plate having a relatively small wall thickness which forms an opening 42 in a portion thereof corresponding to a display region part of the liquid crystal display panel module 400.

[0052]

Further, the intermediate frame 700 has a function of pushing the diffusion plate to the resin frame body 500 and a function of mounting the liquid crystal display panel module 400.

Accordingly, a spacer 44 which positions the liquid crystal display panel 1 is mounted on a portion of an upper surface of the intermediate frame 700 on which the liquid crystal display panel module 400 is mounted. Due to such a constitution, the liquid crystal display panel 1 is accurately positioned with respect to the intermediate frame 700.

[0053]

Further, the intermediate frame 700 is configured such that the side surfaces 46 are integrally formed. That is, the intermediate frame 700 is configured such that the opening 42 is formed in a bottom surface of the substantially box-shaped metal plate.

[0054]

The intermediate frame 700 having such a shape is fitted in the resin frame body 500 in a state that a diffusion plate is sandwiched between the intermediate frame 700 and the resin frame body 500. In other words, the intermediate frame 700 is mounted in the resin frame body 500 in a state that an inner wall of a side surface 46 of the intermediate frame 700 faces an outer wall of a side surface of the resin frame body 500 in an opposed manner.

[0055]

The intermediate frame 700 made of the metal plate having such a constitution forms one frame body (housing) together with the resin frame body 500 and hence, it is possible to increase a mechanical strength of the resin frame body 500 without increasing a wall thickness of the resin frame body 500.

[0056]

That is, even when the intermediate frame 700 and the resin frame body 500 do not possess the sufficient mechanical strength individually, due to the above-mentioned fitting of the intermediate frame 700 and the resin frame body 500, it is possible to enhance the mechanical strength and, particularly, the strength against the twisting around diagonal lines of the box.

[0057]

[upper frame 800]

The upper frame 800 has a function of pushing the liquid crystal display panel module 400, the intermediate frame 700, and the diffusion plate toward the resin frame body 500 side and, at the same time, constitutes an outer frame of a module of the liquid crystal display device together with the resin frame body 500.

[0058]

The upper frame 800 is formed of a metal plate having a box shape, an opening (display window) 48 is formed in a portion of the upper frame 800 corresponding to a liquid crystal display part AR of the liquid crystal display panel module 400, and the upper frame 800 is mounted on the resin frame body 500 by engagement, for example.

[0059]

Embodiment 2.

Fig. 4 is a constitutional view showing another embodiment of the liquid crystal display device according the present invention and corresponds to Fig. 1.

The constitution which makes this embodiment different from the embodiment shown in Fig. 1 lies in that slits SLT which are similar to the slits SLT formed in the video signal drive printed circuit board HPCB are also formed in the scanning signal drive printed circuit board VPCB.

[0060]

Since the stress strain which is generated in this type of signal drive circuit is increased in proportion to a length thereof and hence, it is more effective to form the slits SLT in the video signal drive printed circuit board HPCB than in the scanning signal drive printed circuit board VPCB.

[0061]

However, due to the recent large-sizing of the liquid crystal display panel PNL, a length of the scanning signal drive printed circuit board VPCB is also increased and hence, it is needless to say that the slits SLT may be formed in the scanning signal drive printed circuit board VPCB.

[0062]

Embodiment 3.

Fig. 5 is an explanatory view showing an embodiment of a shape of the slits formed in the video signal drive printed circuit board HPCB or the scanning signal drive printed circuit board VPCB.

[0063]

First of all, in Fig. 5(a), a notch formed in the signal drive printed circuit board has a rectangular shape and a depth of the notch is set to 1mm or more and 5mm or less. The reason for setting the depth of the notch to 1mm or more is that when the depth is below 1mm, the stress relaxation is not obtainable. Further, the reason for setting the depth of the notch to 5mm or less is that when the depth of the notch is above 5mm, a width of the signal drive printed circuit board at the slit SLT portion becomes excessively narrow and hence, a so-called torsional stress is liable to be generated in the signal drive printed circuit board thus increasing the stress applied to the signal drive circuit to the contrary.

[0064]

Further, in Fig. 5(b), a shape of the notch is formed in a "T" shape also having slight notches extending along the longitudinal direction of the signal drive printed circuit board at the center side of the signal drive printed circuit board.

In such a case, from a viewpoint of the transmission of stress, the slight notched portions form play portions and increase the stress relaxation effect.

[0065]

Here, although the shape of the slit SLT formed in each signal drive printed circuit board is not particularly limited. That is, provided that the width of the signal drive printed circuit board at the portion where the slit SLT is formed is set smaller than the width of the signal drive printed circuit board at other portions, it is possible to sufficiently obtain the advantageous effects of the present invention. This understanding is applicable to the slits SLT of respective embodiments explained hereinafter.

[0066]

Embodiment 4.

Fig. 6 is a plan view showing another embodiment of the image display device according to the present invention and corresponds to Fig. 4.

[0067]

The constitution which makes this embodiment different from the embodiment shown in Fig. 4 lies in that in at least one slit SLT out of the respective slits SLT formed in the scanning signal drive printed circuit board VPCB, connecting means CM such as a connector or a flat cable, for example, is arranged, and the slit SLT is used as a path for pulling out wiring on a back surface side of the scanning signal drive printed circuit board VPCB to a front surface side of the scanning signal drive printed circuit board VPCB.

[0068]

This embodiment aims at the reduction of a so-called picture frame size using a so-called marginal space effectively. Here, the picture frame is a region which is sandwiched by an outer frame of the liquid crystal display part AR of the liquid crystal display panel PNL and an outer frame of the liquid crystal display module 400.

[0069]

Embodiment 5.

Fig. 7 is a plan view showing another embodiment of the image display device according to the present invention and corresponds to Fig. 6.

[0070]

The constitution which makes this embodiment different from the embodiment shown in Fig. 6 lies in that the connecting means CM such as the connector or the flat cable, for example, is not arranged in the slit SLT formed in the scanning signal drive printed circuit board VPCB but is arranged in at least one of the slits SLT formed in the video signal drive printed circuit board HPCB.

[0071]

Even in such a case, it is possible to obtain advantageous effects similar to the advantageous effects obtained in the case shown in Fig. 6. Further, it is needless to say that the connecting means CM may be arranged not only on the scanning signal drive printed circuit board VPCB side but also on the video signal drive printed circuit board HPCB side.

[0072]

Embodiment 6.

Fig. 8 is a plan view showing another embodiment of the image display device according to the present invention and corresponds to Fig. 1. Although Fig. 8 corresponds to Fig. 1, the slits SLT are formed in neither the video signal drive printed circuit board HPCB nor the scanning signal drive printed circuit board VPCB.

[0073]

In place of forming the slits SLT, at both ends of the video signal drive printed circuit board HPCB, dummy printed circuit boards DC are formed in a state that dummy printed circuit boards DC are formed between the video signal drive printed circuit board HPCB and the liquid crystal display panel PNL in an astride manner. Further, in the drawing, at both ends of the scanning signal drive printed circuit board VPCB, dummy printed circuit boards DC are formed in a state that dummy printed circuit boards DC are formed between the scanning signal drive printed circuit board VPCB and the liquid crystal display panel PNL in an astride manner.

[0074]

While the dummy printed circuit boards DC may be constituted of a video signal drive circuit He or a scanning signal drive circuit V, for example, it is sufficient that the dummy printed circuit boards DC may be formed of a material having flexibility at least in the same manner as the flexible printed circuit of such circuits. In view of the above, although it is not always necessary to form the wiring layer on surfaces on the dummy printed circuit board, it is preferable to form the wiring layer on surfaces on the dummy printed circuit board by taking the connection between the signal drive printed circuit board and the liquid crystal display panel PNL into consideration.

[0075]

Further, provided that the wiring is formed on the dummy printed circuit boards DC, it is possible to obtain an advantageous effect that a signal such as a common potential signal, a power source potential signal or the like, for example, can be transmitted to the liquid crystal display panel PNL from the signal drive printed circuit board by making use of the wiring.

[0076]

As described above, the influence of the strain attributed to the thermal expansion of the signal drive printed circuit board with respect to the liquid crystal display panel PNL is largely generated on the signal drive circuits which are positioned at both sides out of the respective signal drive circuits which are arranged in parallel and hence, this embodiment allows the dummy printed circuit board DC to bear the influence thus preventing the transmission of the strain to the signal drive circuit which is arranged inside the dummy printed circuit board.

[0077]

Embodiment 7.

Fig. 9 is a plan view showing another embodiment of the image display device according to the present invention and corresponds to Fig. 8.

[0078]

The constitution which makes this embodiment different from the embodiment shown in Fig. 8 lies in that while the dummy printed circuit boards DC are provided, the slits SLT are formed on the respective signal drive printed circuit boards.

[0079]

This embodiment is provided for further enhancing the above-mentioned advantageous effects to ensure the safety. Here, in this embodiment, it is needless to say that, for example, the dummy printed circuit boards DC are provided to the video signal drive printed circuit board HPCB side and the slits SLT are formed on the scanning signal drive printed circuit board VPCB side.

[0080]

Embodiment 8.

Fig. 10(a) is a plan view showing another embodiment of the image display device according to the present invention and corresponds to Fig. 2. Further, Fig. 10(b) is a cross-sectional view taken along a line b-b in Fig. 10(a) and Fig. 10(c) is a cross-sectional view taken along a line c-c in Fig. 10(a).

[0081]

The constitution which makes this embodiment different from the embodiment shown in Fig. 2 lies in that, first of all, the liquid crystal display panel module 400 is shown with respect to the relationship with the intermediate frame 700.

[0082]

Further, projecting portions PJ are, for example, integrally formed on the inside of the intermediate frame 700 and these projecting portions PJ are engaged with or fitted in the respective slits SLT formed in the video signal drive printed circuit board HPCB and the slits SLT formed in the scanning signal drive printed circuit board VPCB.

[0083]

That is, an extending portion EX which allows the mounting of the liquid crystal display panel PNL, the video signal drive printed circuit board HPCB and the scanning signal drive printed circuit board VPCB thereon is formed on the intermediate frame 700 in an extended manner from an inner surface thereof in a state that the extending portion EX does not cover the liquid crystal display part AR of the liquid crystal display panel PNL. Further, the projecting portions PJ are formed in a state that the projecting portions PJ extend from the extending portion EX in the direction perpendicular to the extending portion EX and in a state that the projecting portions PJ are connected to the inner surface of the intermediate frame 700.

[0084]

Then, by arranging the video signal drive printed circuit board HPCB and the scanning signal drive printed circuit board VPCB in a state that the above-mentioned projecting portions PJ are engaged with or fitted into the slits SLT which are respectively formed in the video signal drive printed circuit board HPCB and the scanning signal drive printed circuit board VPCB, it is possible to impart a function of restricting the strain of the video signal drive printed circuit board HPCB and the scanning signal drive printed circuit board VPCB to the constitution.

[0085]

That is, in the video signal drive printed circuit board HPCB and the scanning signal drive printed circuit board VPCB respectively, with respect to the side on which the slits SLT are formed, even when an expansion is generated between one slit SLT and another neighboring slit SLT and the expansion is proportional to a length between the slits SLT, the expansion can be suppressed due to the interference between respective slits SLT and the projecting portions PJ which are engaged with or fitted in the slits SLT.

[0086]

Further, due to such a constitution, it is possible to decrease the deformation attributed to the twisting of the intermediate frame 700 per se or the like (the increase of rigidity) and, at the same time, a contact area of the intermediate frame 700 with the upper frame 800 can be increased by an amount corresponding to the formation of the above-mentioned projecting portions PJ and hence, it is also possible to have an advantageous effect that the deformation of the upper frame 800 can be also prevented. Accordingly, the rigidity of the whole liquid crystal display module can be increased and hence, the disconnection of wiring attributed to the strain of the module can be suppressed.

[0087]

Embodiment 9.

Fig. 11 is a constitutional view showing another embodiment of the liquid crystal display device according to the present invention and corresponds to Fig. 10.

[0088]

The constitution which makes this embodiment different from the embodiment shown in Fig. 10 lies in that projecting portions PG which project in the vertical direction with respect to the extending portion EX are formed on the extending portion EX of the intermediate frame 700.

[0089]

Further, the projecting portions PG are provided between the liquid crystal display panel PNL and the video signal drive printed circuit board HPCB as well as between one video signal drive circuit He and another video signal drive circuit He which is arranged close to one video signal drive circuit He and, further, between the liquid crystal display panel PNL and the scanning signal drive printed circuit board VPCB as well as between one scanning signal drive circuit V and another scanning signal drive circuit V arranged close to one scanning signal drive circuit V, and have a coplanar height with an upper surface of the intermediate frame 700.

[0090]

Due to such a constitution, while possessing the advantageous effects explained in conjunction with Fig. 10, the projecting portions PG can also have a function of supporting the upper frame 800 and hence, it is possible to increase the rigidity of the upper frame 800 per se. Further, since the upper frame 800 is brought into contact with the projecting portions PG, it is possible to disperse the resonance frequency of the upper frame 800 and hence, it is possible to have an advantageous effect that the disconnection at the connecting portion of the wiring attributed to the vibration can be suppressed.

[0091]

The above-mentioned respective embodiments may be used in a single form or in combination. This is because that the advantageous effects of the respective embodiments can be obtained independently or synergistically.

[0092]

Further, although the present invention is explained in conjunction with the liquid crystal display device, it is needless to say that the present invention is also applicable to other image display device such as an organic EL display device or the like, for example. This is because that other image display device substantially has the same constitution as the liquid crystal display device except for the display panel.

[0093]

[Advantageous effect of the invention]

As can be clearly understood from the foregoing explanation, according to the image display device of the present invention, it is possible to avoid the disconnection or the like in the signal drive circuit.

[Brief explanation of drawings]

[Fig. 1]

A plan view showing one embodiment of a display panel module of an image display device according to the present invention.

[Fig. 2]

An exploded perspective view showing one embodiment of the image display device according to the present invention.

[Fig. 3]

An equivalent circuit diagram showing one embodiment of the display panel module of the image display device according to the present invention.

[Fig. 4]

A plan view showing one embodiment of the display panel module of the image display device according to the present invention.

[Fig. 5]

A constitutional view showing slits formed in a signal drive circuit of the image display device according to the present invention.

[Fig. 6]

A plan view showing another embodiment of the display panel module of the image display device according to the present invention.

[Fig. 7]

A plan view showing another embodiment of the display panel module of the image display device according to the present invention.

[Fig. 8]

A plan view showing another embodiment of the display panel module of the image display device according to the present invention.

[Fig. 9]

A plan view showing another embodiment of the display panel module of the image display device according to the present invention.

[Fig. 10]

A constitutional view showing another embodiment of the image display device according to the present invention.

[Fig. 11]

A constitutional view showing another embodiment of the image display device according to the present invention.

[Fig. 12]

A plan view showing one embodiment of an actually designed liquid crystal display panel in the image display device according to the present invention.

[Explanation of symbols]

SUB: transparent substrate, GL: gate signal line, DL: drain signal line, TFT: thin film transistor, PX: pixel electrode, CT: counter electrode, HPCB: video signal drive circuit, He: video signal drive circuit, VPCB: scanning signal drive circuit, V: scanning signal drive circuit, SLT: slit, CM: connecting means, DC: dummy printed circuit board, PJ: projecting portion, EX: extending portion, PG: projecting portion, 700: intermediate frame, 800: upper frame.

[Designation of Document]

[ABSTRACT]

[Task] To avoid a disconnection or the like in a signal drive circuit.

[Means for solving the task]

In an image display device which includes an image display panel, a first printed circuit board which is arranged close to the image display panel, and a second printed circuit board which is arranged in a state that the second printed circuit board strides over the image display panel and the first printed circuit board,

the second printed circuit board is configured in a state that at least a wiring layer which allows the inputting of signals from the first printed circuit board thereto and the outputting of signals to the image display panel side therefrom is formed on a surface of a flexible printed circuit board, and

the first printed circuit board includes, on a side thereof opposite to the image display panel, a portion thereof having a width smaller than a width of the first printed circuit board.

[Selected drawing]

Fig. 1